# Survey Paper on Emotion Recognition

**Prachi Shukla, Sandeep Patil**

***Abstract*— Facial expressions give important information about emotions of a person. Understanding facial expressions accurately is one of the challenging tasks for interpersonal relationships. Automatic emotion detection using facial expressions recognition is now a main area of interest within various fields such as computer science, medicine, and psychology. HCI research communities also use automated facial expression recognition system for better results. Various feature extraction techniques have been developed for recognition of expressions from static images as well as real time videos. This paper provides a review of research work carried out and published in the field of facial expression recognition and various techniques used for facial expression recognition.**

***Index Terms*— Automated facial expression recognition system, Face detection, Emotion detection, and Human Computer Interaction(HCI).**

## I. Introduction

Detecting emotion has been an increasingly popular research topic in recent year. Recent research is done on emotion detection from text. Their applications range from advertisement and commercial purposes to medical patient behavior analysis. Applying this in a social network setting, it can be a powerful tool to gain knowledge about how individuals, social circles, communities, or cities feel about current events or other such topics. Emotion Recognition with the help of images is a growing research field. Emotion from images is to detect changes in facial expressions in according to an individual's internal emotion state and intentions. Human face is a significant place for detecting emotions, six emotions detected from human face. They are Happy, Surprise, Anger, Sad, Fear and Neutral. This paper has covered some techniques which are used for emotion recognition from images. The techniques are discussed below in brief.

## II. Facial Feature Extraction

Contracting the facial muscles produces changes in both the direction and magnitude of skin surface displacement, and in the appearance of permanent and transient facial features.
Examples of permanent features are eyes, brow, and any furrows that have become permanent with age. Transient features include facial lines and furrows that are not present at rest. In order to analyze a sequence of images, we assume that the first frame is a neutral expression. After initializing the templates of the permanent features in the first frame, both geometric facial features and Gabor wavelets coefficients are automatically extracted the whole image sequence. No face crop or alignment is necessary.

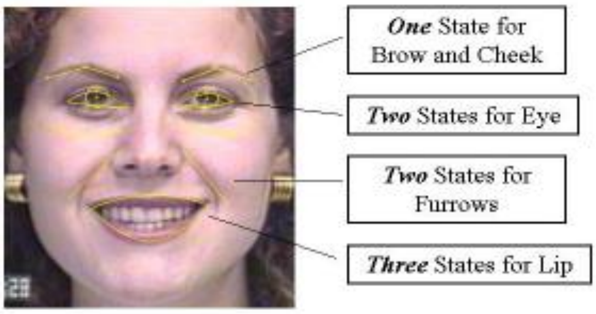


**Figure 1. Multi-state models for geometric feature extraction**

To detect and track changes of facial components in near frontal face images, multi-state models are developed to extract the geometric facial features (Fig. 1). A three-state lip model describes lip state: open, closed, and tightly closed.

A two-state model (open or closed) is used for each of the eyes. Each brow and cheek has a one-state model. Transient facial features, such as nasolabial furrows, have two states: present and absent. Given an image sequence, the region of the face and approximate location of individual face features are detected automatically in the initial frame. The contours of the face features and components then are adjusted manually in the initial frame. Both permanent(e.g., brows, eyes, lips) and transient (lines and furrows) face feature changes are automatically detected and tracked in the image sequence. We group 15 parameters which describe shape, motion, eye state, motion of brow and cheek, and furrows in the upper face. These parameters are geometrically normalized to compensate for image scale and in-plane head motion based two inner corners of the eyes.

**Gabor Wavelets :**

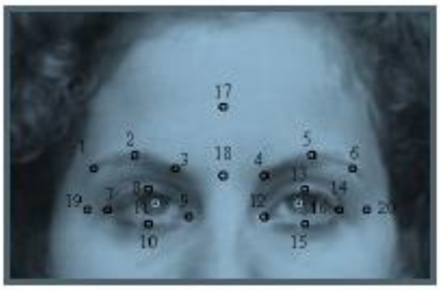

**Fig.2 Locations to calculate Gabor coefficients in Upper Face**

We use Gabor wavelets to extract the facial appearance changes as a set of multi-scale and multi-orientation

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coefficients. The Gabor filter may be applied to specific locations on a face or to the whole face image [4, 5, 9, 17, 20]. Following Zhang et al., we use the Gabor filter in a selective way, for particular facial locations instead of the whole face image.

The response image of the Gabor filter can be written as a correlation of the input image $I(x)$, with the Gabor kernel $p_k(x)$

$$a_k(x_0) = \iint I(x) p_k(x - x_0)\, dx \text{-(1)}$$

where the Gabor filter $p_k(x)$ can be formulated :

$$p_k(x) = \frac{k^2}{\delta^2} e^{\left(\frac{-k^2}{2\delta^2}x^2\right)} \left(e^{ikx} - e^{\frac{-\delta^2}{2}}\right) \text{-(2)}$$

where **k** is the characteristic wave vector.

In our implementation, 800 Gabor wavelet coefficients are calculated in 20 locations which are automatically defined based on the geometric features in the upper face (Figure 2). We use $\delta = \pi$ five spatial frequencies with wave numbers $ki$ = ( $\pi/2$ , $\pi/4$ , $\pi/8$ , $\pi/16$, $\pi/32$ ), and 8 orientations from 0 to $\pi$ differing by $\pi/8$. In general, $p_k(x)$ is complex.

In our approach, only the magnitudes are used because they vary slowly with the position while the phases are very sensitive. Therefore, for each location, we have 40 Gabor wavelet coefficients.

## III. FACE CLASSIFICATION ALGORITHM :

The algorithm can be divided into two broad steps: registration of a grid with the face and face classification based on feature values extracted at grid points. In this paper, facial grids are registered either automatically, using labeled elastic graph matching or by manually clicking on points of the face which describes basic research on facial expression recognition).This paper is concerned with face classification after the grid has been registered and the algorithm may be adapted for use with other grid registration schemes. Labeled elastic graph matching has been described in detail in the papers cited and will not be discussed in depth here.

Images are first transformed using a multiscale, multi orientation set of Gabor filters (Fig. 3). The grid is then registered with the face. Two types of grid are considered in this paper: a rectangular grid and a fiducial grid with nodes located at easily identifiable landmarks of the face . The amplitude of the complex valued Gabor transform coefficients are sampled on the grid and combined into a single vector, the labeled graph vector (or LG vector in Fig. 3). The ensemble of LG vectors from a training set of images are subjected to principal components analysis (PCA) to reduce the dimensionality of the input space. LG vectors project into the lower dimensional PCA space (LG-PCA vectors). Input vectors in the original LG space may then be analyzed using the same LDA to determine their attributes.

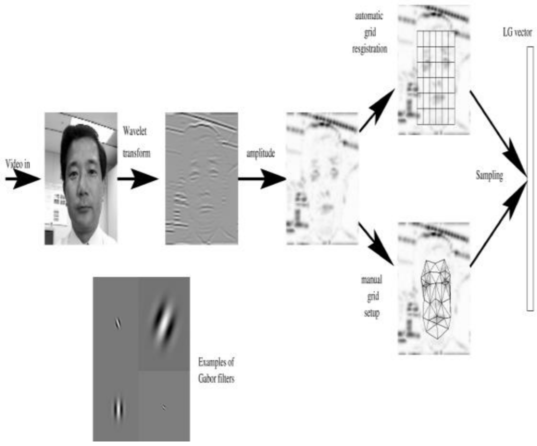



**Fig.3 The Gabor –labelled elastic graph representation of an facial image.**

The best performances were obtained using a Gabor wavelet representation and independent component analysis. All of these systems used a manual step to align each input image with a standard face image using the center of the eyes and mouth.Gabor wavelets can achieve high sensitivity and specificity for emotion-specified expressions (e.g.,happy, sad) and single AUs under four conditions.(1) Subjects were homogeneous either all Japaneseor all Euro-American. (2) Head motion was excluded. (3)Face images were aligned and cropped to a standard size.(4) Specific-emotion expression or single AUs were recognized.

In multi-culture society, expression recognition must be robust to variations of face shape, proportion, and skin color. Facial expression typically consists of AU combinations ,that often occur together with head motion. AU s can occur either singly or in combination. When AU occuring combination they may be additive, in which the combination does not change the appearance of the constituent AUs, or non-additive, in which the appearance of the constituents does change. The non-additive AU combinations make recognition more difficult.

Investigation of the AU recognition accuracy of Gabor wavelets for both single AUs and AU combinations will be done. There are three basic steps namely **Face detection, Feature Extraction, Classification.**

## IV. METHODOLOGY :

### A. *Face Detection*

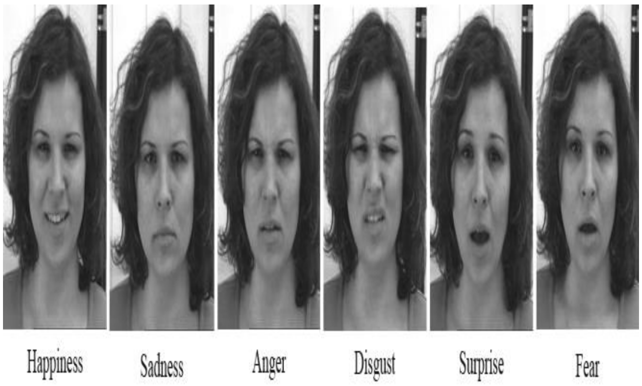
Given an image, detecting the presence of a human face is a complex task due to the possible variations of the face. The different sizes, angles and poses human face might have within the image cause this variation. The emotions which are deducible from the human face and different imaging conditions such as illumination and occlusions also affect facial appereances. The approaches of the past few decades in face detection can be classified into four: knowledge-based

approach, feature invariant approach, template –based approach and appearance-based approach.

### *B. Facial Feature Extraction*

Contracting the facial muscles produces changes in both the direction and magnitude of skin surface displacement ,and in the appearance of permanent and transient facial features. Examples of permanent features are eyes, brow, and any furrows that have become permanent with age. Transient features include facial lines and furrows that are not present at rest. In order to analyze a sequence of images, we assume that the first frame is a neutral expression. After initializing the templates of the permanent features in the first frame, both geometric facial features and Gabor wavelets coefficients are automatically extracted the whole image sequence. No face crop or alignment is necessary.

### *C. EMOTION CLASSIFICATION*




## V. CONCLUSION-

In this paper the automatic facial expression recognition systems and various research challenges are overviewed. Basically these systems involve face recognition, feature extraction and categorization. Various techniques can be used for better recognition rate. Techniques with higher recognition rate have greater performance .These approaches provide a practical solution to the problem of facial expression recognition and can work well in constrained environment. Emotion detection using facial expression is a universal issue and causes difficulties due to uncertain physical and psychological characteristics of emotions that are linked to the traits of each person individually. Therefore, research in this field will remain under continuous study for many years to come because many problems have to be solved in order to create an ideal user interface and improved recognition of complex emotional states is required**.** In Case of a Dark person with a Bright Background, this System will be able to detect face with more accuracy. We will be able to detect Side Faced Images from them as it will be able to extract face feature. In this system there is no as such limitations of using Lips as Neuron to detect emotion. So we will also be able to detect some of the mixed emotions.

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